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EDITORIAL

Atrial fibrillation burden: a 'hard' indicator of therapeutic efficacy and a prognostic marker to boot ?

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This editorial refers to 'What is the real atrial fibrillation burden after catheter ablation of atrial fibrillation? A prospective rhythm analysis in pacemaker patients with continuous atrial monitoring'† by D. Steven *et al.*, on page 1037

Atrial fibrillation (AF) is associated with embolic accidents and heart failure as well as increased mortality.[1] Associated heart disease is known to be an important factor determining mortality.[1] On the other hand, the significance of the arrhythmia in patients with lone AF has been more difficult to prove perhaps because of the difficulty of measuring the time spent in AF, the burden of AF, and thus establishing a dose–effect relationship. Somewhat paradoxically, a recent consensus statement[2] does not distinguish between the prognostic implications of paroxysmal vs long-standing chronic AF while at the same time recommending anticoagulation before cardioversion of long-lasting AF but not for AF of recent onset.

From a mechanistic point of view, the longer the atria remain in fibrillation, the greater the stasis and the likelihood of stasis-generated thrombi. In experimental models, short durations of AF result in less electrical and structural atrial remodelling.[3] The duration of atrial stunning following cardioversion may also be proportional to the duration of preceding AF,[4] favouring continuing stasis despite the restoration of sinus rhythm. A systemic embolic accident also requires the ejection of left atrial thrombi into the systemic circulation, and reversion to sinus rhythm can provide a sufficiently powerful atrial appendage contraction.

One possible reason why the AF burden is not recognized as a prognostic marker may be the difficulty of reliably estimating it. AF is often intermittent and capricious. The patients' perception of fibrillation is frequently far from perfect and often this arrhythmia generates no symptoms. The administration of AV nodal blocking drugs can modify or suppress symptoms. Some patients may unconsciously adapt their lifestyle to avoid symptoms resulting from heart rate acceleration, while still others may possibly have altered sensibility (neuropathies, surgical denervation, etc.).

Estimating AF burden

A resurgence of interest in estimating AF burden is undoubtedly the result of the popularity of catheter ablation (CA). In the absence of justification for an AF burden threshold for complications (chiefly embolic), complete elimination has been the accepted goal of CA of AF. Instead of estimating the residual AF burden, most groups try to maximize the chances of detecting residual AF, relying on the absence of documented AF and symptoms as the standard of a successful intervention.

To this end, 24 h and 7 day Holter recordings,[5] event monitors, and transtelephonic monitoring[6] have all been utilized. Clearly the probability of detecting transient arrhythmias increases directly in proportion to the monitored time period. Thus 7 day Holter recordings are more sensitive than 24 h Holter recordings.[5] Event monitors are best used to analyse symptomatic events, while transtelephonic monitoring provides a convenient and frequent snapshot and can be used as an event monitor. Sensitivity is however limited by the surveillance period, while the specificity of arrhythmia diagnosis using a typical 3-lead surface ECG over any length of time is not optimal. The skin electrodes are difficult to maintain over longer periods because of soreness or allergic reactions, and are incompatible with some routine activities. It is therefore impractical to extend surface ECG monitoring beyond 7 days.

Purerfellner *et al.*[7] were probably the first to use the atrial Holter function of implanted pacemakers for monitoring purposes in patients who underwent CA for AF. Verma *et al.*[8] used mode switch episodes as an estimate of the AF burden. This latter measure is clearly a less precise measure of the AF burden when compared with a 'full disclosure' measurement of a high atrial rate event burden such as in the study of Purerfellner *et al.*[7]

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Steven *et al.*[9] describe AF burden measurement in a group of 37 patients with implanted dual-chamber pacemakers undergoing CA of paroxysmal or persistent AF. Although a variety of devices were implanted, the majority possessed beat to beat detection of high rate episodes, and intracardiac markers and electrograms were reviewed to verify the arrhythmia diagnosis. The authors observed a reduction in AF burden immediately after ablation, and confirmed a further reduction in the first 3 months. They did not, however, include a control group monitored without the help of implantable devices. During the follow-up period, none of the patients with pacemaker documentation of AF recurrence remained completely asymptomatic. While this insight provides support for simple symptomatic follow-up, all their patients were highly symptomatic before ablation and we do not know whether the same results would be obtained for patients with pre-existing asymptomatic AF. The absence of a correlation between symptoms and arrhythmia documentation in the patients of Steven *et al.* prior to ablation is a limitation. The authors' conclusions with regard to the reliability of symptomatic follow-up after CA of AF must therefore be received with caution.

Implantable pacemakers are clearly not suited for a role as an arrhythmia surveillance device. They are complex, expensive, and vulnerable to potentially devastating complications because they are attached by leads to the endocardium. The presence of intracardiac leads may be a hindrance during catheter manipulation; moreover, they can be damaged or dislodged during the procedure.

Simple, inexpensive, easy to implant (and explant!) leadless devices may be able to fulfil many of the requirements described above. The recently modified Reveal XT (Medtronic) is surely the first of a growing trend. Although relying principally on R wave irregularity and presently limited in its memory capacity, such devices offer truly constant surveillance. Further miniaturization, multiple small leadless electrodes, and a larger memory could allow refined surface ECG diagnostics, robust measurement of AF burden, and even vectorial analysis.

After CA of AF, the longer the follow-up, the greater the certainty about rhythm outcome. An implantable rhythm monitoring device may achieve high (or higher) levels of certainty within a shorter follow-up and provide a 'hard' indicator of the efficacy of CA. Implantable devices are ideal in order to prove (or disprove) the relationship of atrial burden to the complications of AF, e.g. embolic accidents. Recent data suggest that high rate atrial episodes lasting more than a day do correlate with an increased incidence of embolic accidents.[10] Although the work of Stevens *et al.*[9] has provided support for the importance of AF burden, prospective data in larger cohorts and with a longitudinal follow-up are needed hopefully to validate AF burden as a predictor of AF-related embolic complications.

Conflict of interest: none declared.

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